REMARKS

Claims 1, 4-6, 9-11, 14-16, 19-21 and 25-49 were pending in the application. Claims 1, 4-6, 9-11, 14-16, 19-21 and 25-49 are rejected under 35 U.S.C. § 103 (a) as being deemed unpatentable over U.S. Patent No. 5,699,440 (Carmeli) in view of Applicants' Admitted Prior Art and U.S. Patent No. 6,052,124 (Stein *et al.*). Claims 50 and 51 are newly added. Support for the newly added claims is in the Applicants' specification as originally filed. (*See* Page 13, lines 18-22 and Page 3, lines 20-24.) Of the Claims, Claims 1, 6, 11, 16, 21, 46, 49 and 50 are independent Claims. The rejections are respectfully traversed and reconsideration is requested.

Regarding rejection under 35 U.S.C. § 103(a)

Claims 1, 4-6, 9-11, 14-16, 19-21 and 25-49 are rejected under 35 U.S.C. § 103 (a) as being deemed unpatentable over U.S. Patent No. 5,699,440 (Carmeli) in view of Applicants' Admitted Prior Art and U.S. Patent No. 6,052,124 (Stein *et al.*).

The applicants' claimed invention is directed to the use of camera defects that result in pixel intensity drop off in a digitized image to recover intrinsic parameters (e.g. focal length) of a camera. The camera optical and physical shortcomings are used to extract the camera parameters. Due to camera defects, there is a pixel intensity drop off in the digitized image. This pixel intensity drop off is based on geometric and optical defects of the camera. The pixel intensity drop off is caused by a combination of a vignetting effect (a reduction in illumination of image points at the edge of the image (see equation 14 in the applicants' specification)) which is geometric in nature (based on partial obstruction of light by the lens stop) and an off-axis illumination effect (illumination of the image point varies across the field of view in proportion to the fourth power of the cosine of the angle between the light ray and the optical path (see equation 5 in the applicants' specification)) which is optical in nature. The intensity of a pixel (image point) in the digitized image is dependent on a combination of these effects (geometric and optical). Camera defects (optical and geometric in nature) are used to recover the intrinsic parameters. Thus, through the use of camera defects, the Applicants' claimed technique recovers a camera intrinsic parameter from a single image of a blank textureless surface.

Cited prior art Carmeli merely discusses measuring the electro-optical performance representative of illumination uniformity based on evaluating the effect of vignetting on an output signal. (*See* Col 5, lines 52-57; Col. 6, lines 48-50; Col. 9, lines 52-61; Col. 11, line 16 and Col. 14, lines 7-18.) Cited prior art Stein discusses the use of specialized patterns to recover intrinsic parameters of the camera.

To establish a prima facie case for obviousness under 35 U.S.C. § 103 (a), (1) there must be some suggestion or motivation to combine reference teachings. (2) There must be a reasonable expectation of success. (3) The references when combined must teach or suggest all the claim limitations. For the reasons discussed below, it is respectfully submitted that the Office has not established a prima facie case under 35 U.S.C. § 103 (a) for claims 1, 4-6, 9-11, 14-16, 19-21 and 25-49, and that therefore, claims 1, 4-6, 9-11, 14-16, 19-21 and 25-49 are allowable.

Prior art methods for calibration, including the calibration method discussed in cited prior art Stein and in the background section of the present invention require some form of image feature, or registration between multiple images in order to extract camera parameters. In contrast, the Applicants claim a simple method for calibrating a camera without the use of specialized patterns or registration as required by the prior art. The intrinsic parameters (e.g. focal length) of the camera are recovered using substantially only the pixel intensity drop off in the digitized image. One advantage of the Applicants' claimed calibration technique is that no special patterns are required. Thus, using known camera defects (pixel intensity drop off and off-axis illumination) to extract intrinsic parameters, all that is required, is a single blank piece of paper.

Carmeli's mere discussion of measurement of illumination uniformity does not teach or suggest at least the Applicants' claimed " determining pixel intensity drop off caused by a combination of a vignetting effect and an off-axis pixel projection effect due to camera defects" as claimed by the Applicants in amended claim 1. There is no teaching or suggestion in Stein to use other than well-known methods for recovering intrinsic parameters of a camera. There is no teaching or suggestion in Carmeli to recover intrinsic parameters of a camera. In contrast, these parameters are already known and stored in a database. There is no teaching or suggestion in

Carmeli to use the result of the measurement of illumination uniformity to recover intrinsic parameters of the camera. The measured illumination unfortunately is the end result.

U.S. Patent No. 4,887,123 (Wally) merely discusses that the illumination of a point varies with the fourth power of the cosine of an angle. However, Wally does not suggest the use of this illumination effect to extract an intrinsic parameter of the camera as claimed by the Applicants. In contrast, Wally discusses a method for counteracting this effect. (*See* col. 3, lines 20-52.) Thus, Wally's discussion of eliminating this illumination effect teaches away from the use of this illumination effect to extract an intrinsic parameter as claimed by the Applicants.

There is no suggestion or motivation to combine Carmeli, Stein and Applicants' admitted prior art and the references when combined do not teach or suggest all the claim limitations. The combination of Carmeli, Applicants' admitted prior art and Stein merely teaches use of specialized patterns to obtain intrinsic parameters, storing the obtained parameters into a database and then using the parameters stored in the database to test the performance of the camera.

The foregoing patentable distinctions are recited in base claims 1 and 6 with the language or similar language:

> "recovers an intrinsic parameter of the camera other than pixel intensity drop off based on substantially only the determined pixel intensity drop off"

Independent claim 11 recites a like distinction in terms of a computer system and thus similarly patentably distinguishes over the prior art. Independent claims 16 and 21 recite a like distinction in terms of an apparatus. Independent Claim 46 includes like limitations distinguishing the cited art.

Claims 4-5 and 9-10 are dependent on base claims 1 and 6 respectively and thus include this limitation over the prior art. Claims dependent on claims 11, 16 and 21 include this limitation over the prior art. Claims 47 and 48 are dependent on base claim 46 and thus follow.

Dependent claims 4, 9, 14 and 19 recite that "the step of computing is dependent on a camera tilt effect" that is neither taught nor suggested by Carmeli. The align step discussed by Carmeli does not teach or suggest a camera tilt effect. In contrast, the align step aligns an image so as to provide sharp focus and correct for optical magnification so that the target is correctly aligned to the lens and camera. An image is formed and is aligned so as to produce sharp focus

and correct for optical magnification so that the target is correctly aligned to the lens and camera. (*See* Col. 2, lines 52-55.)

Dependent claims 5, 10, 15, 20 and 25 recite "computing the parameters of a model by minimizing the difference between the digitized image and the model" that is neither taught nor suggested by Carmeli. Carmeli merely stores parameters in a database and uses the stored parameters to form and align an image. (*See* Col. 6, lines 39-50.)

Accordingly, the present invention as now claimed is not believed to be anticipated by or made obvious from the cited art or any of the prior art. Removal of the rejections under 35 U.S.C. §103 (a) and acceptance of Claims 1, 4-6, 9-11, 14-16, 19-21 and 25-51 is respectively requested.

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned.

Respectfully submitted,

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